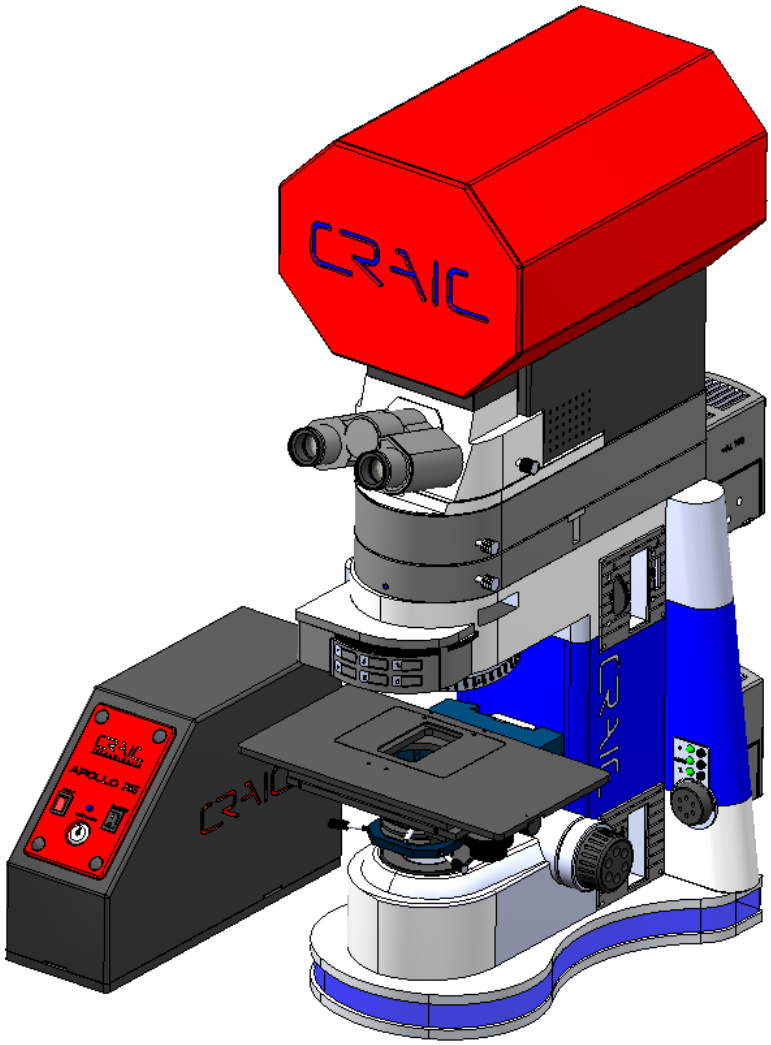
CRAIC Apollo™ 785 Raman Microspectrophotometer User's Manual



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Version 1.2.0

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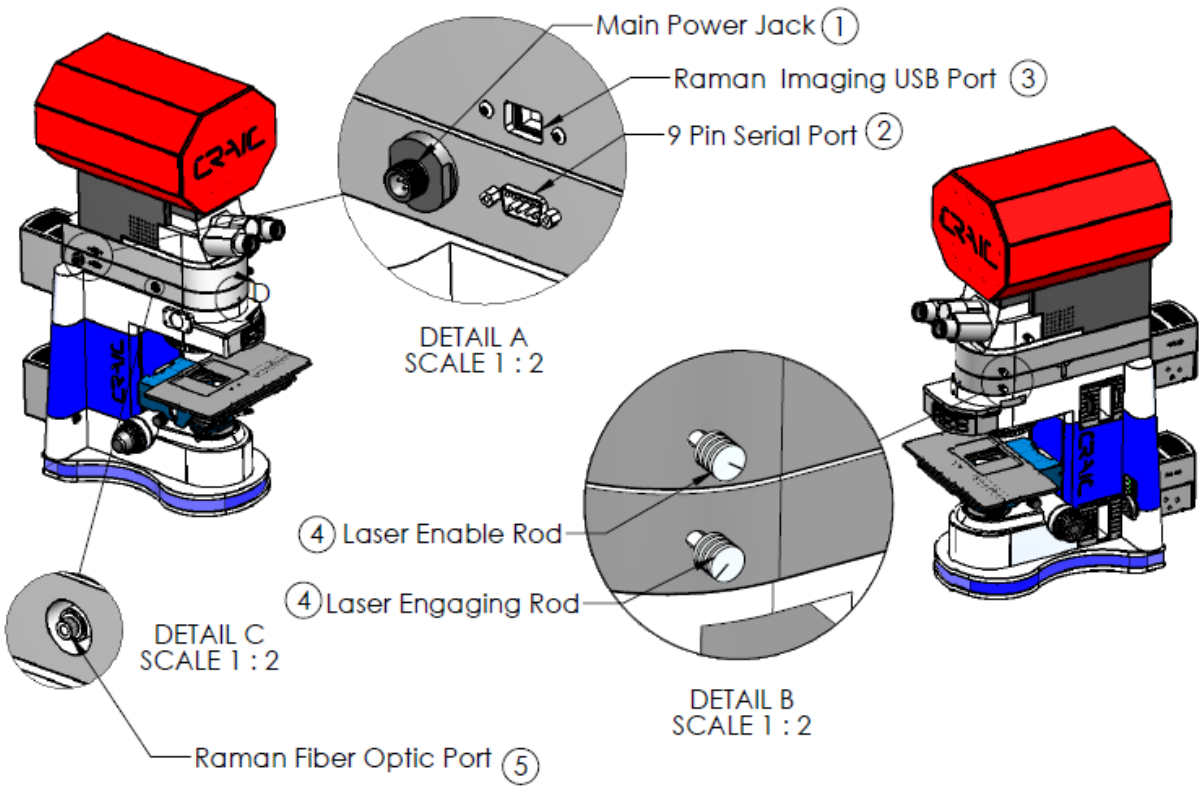
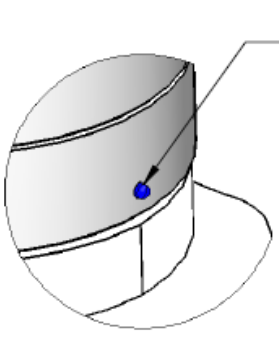
CRAIC TECHNOLOGIES

INSTALLATION DIAGRAM





INSTRUCTIONS:

1. Attach the yellow cable from the Raman Control Unit to the Main Power Jack on the Raman Head Unit.
2. Attach one end of the 9 pin serial cable provided to the 9 Pin Serial Port on the Raman Head Unit.
3. Connecto one end of the Type B USB cords provided to the Raman Imaging USB Port and the other end to the computer USB port.
4. Push Laser Engaging Rod outward to the engage the Laser on and the imaging LED . The laser will only turn on when it has been enabled from the key switch on the Raman Control Unit and when the enable rod is pulled out.Refer to step 16 for instructions on how to enable the laser. Pull Laser Engaging Rod outward to turn the laser on and inward to turn it off.
5. Connect one end of the fiber optic cable provided to the Raman Fiber Optic Port on the Raman Head Unit. Connect the other end of the cable to the Fiber Optic Port located on the Raman Control Unit.
6. The Head Unit Laser Enable Indicator LED will only turn on only when the Laser is active. It will turn on and off with the Laser and serves as an indicator to alert the user when the laser is on.

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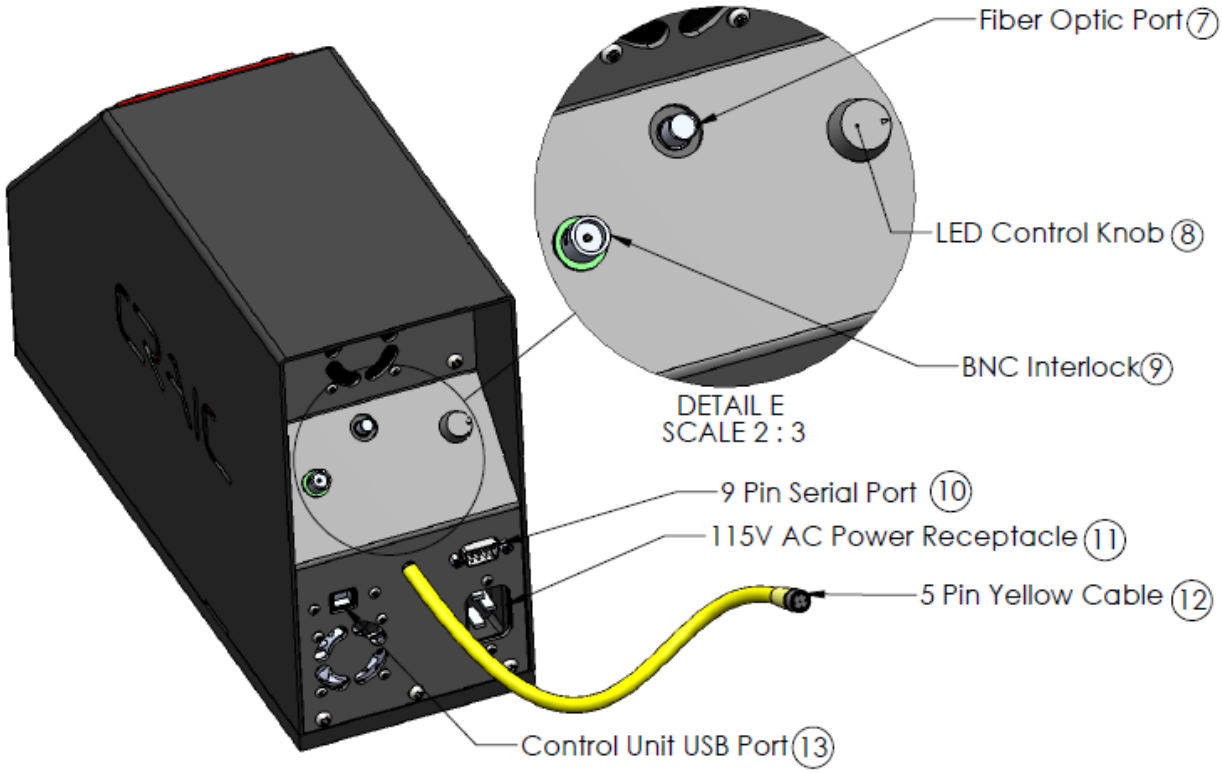
Fiber Optic Port 7
LED Control Knob 8
BNC Interlock 9
DETAIL E
SCALE 2 : 3
9 Pin Serial Port 10
115V AC Power Receptacle 11
5 Pin Yellow Cable 12
Control Unit USB Port 13

Instructions:

7. Connect one end of the fiber optic cable provided to the Fiber Optic Port on the Raman Control Unit and the other end to the Fiber Optic Port on the Raman Head Unit.
8. Use the LED control knob to adjust the light intensity for imaging samples by turning the knob on the back of the Raman control unit.
9. The BNC Interlock consists of a standard Female BNC connector. Removing the shorting cap will permanentlydisable the laser. The Interlock has been provided to allow for an auxillary switch if one is desired. Shorting the connection will enable the laser and opening the circuit, by removing the shorting cap, will disable it. An auxillary switch, that makes use of the BNC Interlock, is not provided by CRAIC Technologies.
10. Connect the other end of the 9 pin serial cable provided to the 9 Pin Serial Port localted on the Raman Control Unit.
11. Use the black power cable provided and connect the male end of the cord into the 115V Power Receptacle of the Raman Control Unit. Use in combination with a surge protector and provide only 115V AC for powering the unit.
12. Connect the 5 Pin Yellow Cable to the Main Power Jack of the Raman Head Unit. The cord is configured to fit into the Main Power Jack in a specific orientation. Insert the cable so that it slips into place and screw on to secure.
13. Connect one of the Type B USB cords provided to the USB Port on the Raman Control Unit and connect the other end toa USB port on the computer.

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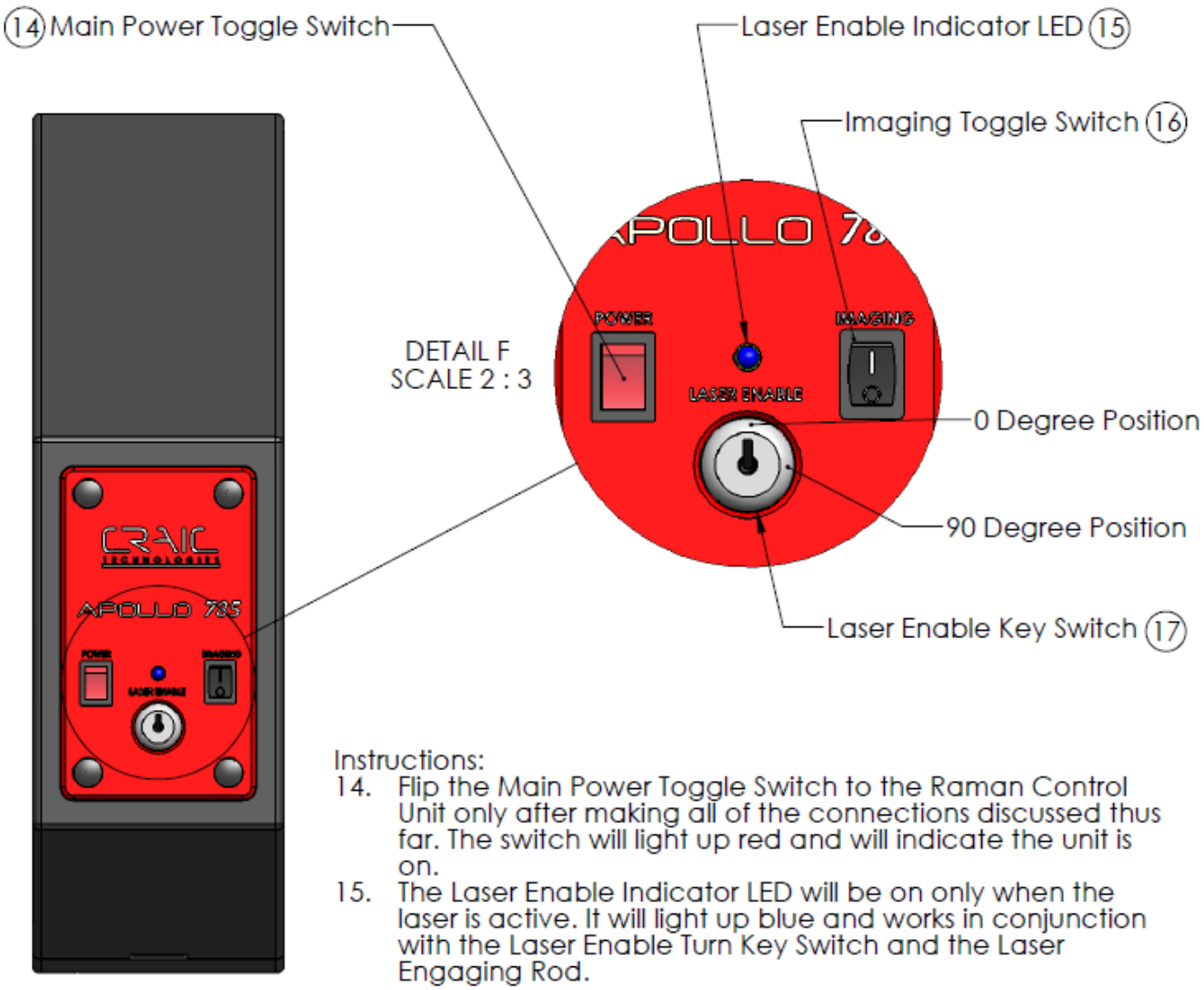

Instructions:

14. Flip the Main Power Toggle Switch to the Raman Control Unit only after making all of the connections discussed thus far. The switch will light up red and will indicate the unit is on.
15. The Laser Enable Indicator LED will be on only when the laser is active. It will light up blue and works in conjunction with the Laser Enable Turn Key Switch and the Laser Engaging Rod.
16. Flip Imaging Toggle Switch to utilize the reflectance imaging of the raman system. Turn on and off as needed to view a sample. Make sure that the Imaging is turned off before taking any raman spectra as it may interfere with aquiring a signal. Turn off imaging when not in use.
17. The Laser is enabled when the Key Switch is in the 90 Degree Position as shown in the detailed view above. The Laser Enable Key Switch must be in the 90 Degree position and the Laser engaging rod must be pulled outward in order to turn the Laser on.

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SPECIFICATIONS

GENERAL BEHAVIOR	
Instrument Range	80cm-1 to 2100cm-1
Resolution	9.8 cm-1 (0.6 nm) full-width half-max at 1000cm-1

LASER SPECIFICIATIONS	
Center Wavelength	785 nm
Power	100 mW Typical
Spectral Linewidth	< 0.02 nm (0.3 cm-1)
Polarization	S-polarized
Polarization ratio	Min. 20dB, typ. >30dB
Output Power Variation	< 1% after 3 minute warm-up period
Lifetime	>10,000 hours

IMAGING SPECIFICATIONS WITH SHIPPING ZEISS EC PLAN NEOFLUAR 20X OBJECTIVE	
Horizontal field of view	300 micron
Vertical field of view	240 micron
Illumination wavelength	455 nm
Illumination linewidth	20 nm
CMOS Sensor resolution	1.4 MPixels

ENVIRONMENTAL	
Mains voltage	115V **ONLY**
Frequency	50 – 60 Hz ~
Use	Indoors only
Operating temperature	10 – 30 °C
Relative humidity	0 – 80 % to 30 °C

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IMPORTANT SAFETY INFORMATION

This manual is an integral part of the product and must be read carefully before switching on and using the CRAIC Raman spectrometer. It contains important instructions and information for the safe operation and maintenance of the product and must therefore be kept in a safe place. The information in the manual is extremely important and should be adhered to under all circumstances. **Hazardous radiation exposure may result if the instructions in this manual are not obeyed.**

When using the CRAIC Apollo™ instrument, diffuse scattering of the laser presents a significant eye hazard. Users must wear appropriate goggles with OD 6 blocking at 785 nm.

Remote Interlock Connector

In accordance with CFR 1040.10(f)(3), a remote interlock connector has been provided. The purpose of the remote interlock connector is to permit the user to connect a remote barrier interlock, emergency stop switch, or similar device. The instrument ships with the interlock shorted via a BNC shorting cap. **Removing this cap will prevent the laser from being enabled.**

To utilize the optional interlock, you may connect a BNC cable to an emergency stop switch.

The interlock is entirely optional, and may be left alone for normal operation.

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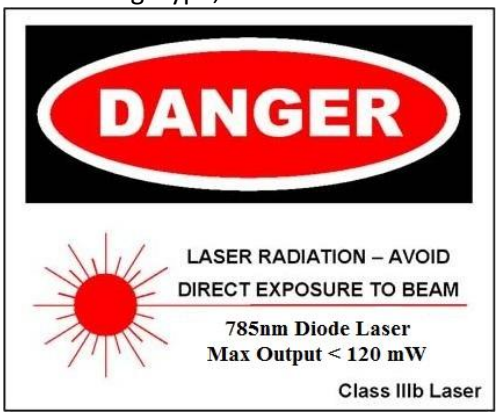
LABEL REPRODUCTIONS AND LOCATIONS ON PRODUCT:

Identification label, located on back of control unit:

DANGER logotype, located on side of head unit:



Certification label, located on back of control unit:

This product complies with FDA performance standards 21 CFR 1040.10 and 1040.11.

Aperture label, located on bottom of head unit (not visible on 20/30 product):

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GENERAL INFORMATION

Installation site

Make sure that the workplace is free from oil and chemical fumes. Vibrations, direct sunlight and major temperature deviations have a negative effect on measurements and spectrophotometry. This and an ergonomically designed chair, which can be adjusted in several positions, are the basic prerequisites for fatigue-free microspectroscopy.

Electric safety

To ensure that the Spectrometer and accessories are in a perfectly safe condition, please note the following advice and warnings: The mains plug must only be inserted into a grounded, 115V outlet. If an extension cord is used, it must be grounded as well. Using the ground connection, any accessories connected to the Spectrometer, which have their own, and/or a different power supply can be given the same ground conductor potential. Please consult our servicing personnel if you intend to connect units without a ground conductor.

Safety and Warranty Violations

The instruments and accessories described in the manual have been checked for safety or possible risks. Before making any alterations to the equipment or combining it with non-CRAIC components in any way not described in this manual, consult the CRAIC agency for your region or the main factory in California. Any guarantee or warranty will be rendered invalid if the instrument is opened or modified in any way by unauthorized persons or if the instrument is used in any way other than described in these instructions!

CE Marking

This instrument meets the requirements of Directives of Electromagnetic Compatibility (EMC) 89/336/EEC, 92/31/EEC, 93/68/EEC and Low Voltage Directives (LVD) 73/23/EEC, 93/68/EEC.

RoHS and WEEE Directives

CRAIC Technologies is exempt from the RoHS Directive 2002/95/EC under Category 9 of Annex 1(a) of Directive 2002/96/EC. In the EC, please contact your local Sales Representative regarding disposal.

FDA Compliance Statement

This product complies with FDA performance standards 21 CFR 1040.10 and 1040.11.

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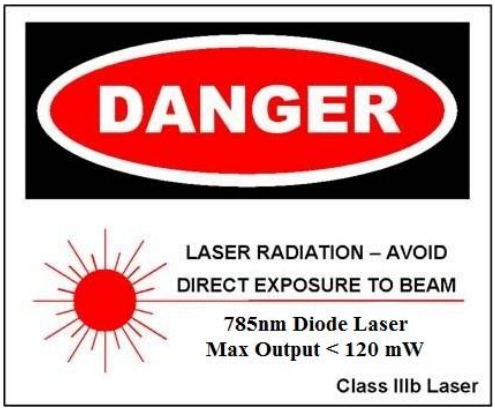
Operation of the CRAIC Apollo™ Raman Spectrometer

The operation portion of this manual is divided into sections. There is the introduction, overview of the software, and checking the calibration of the instrument; then there is a section for each type of spectroscopy that can be run using the CRAIC Apollo™ system.

Note on Laser Light Source



Always wear safety goggles rated for OD6 at 785nm. Call CRAIC technologies for assistance in selecting appropriate laser safety goggles.

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CRAIC Raman Software

Upon software launch, the main window will be displayed. (**Figure 1**) Data can be taken while simultaneously viewing the sample via digital camera. There are various parts to the LambdaFire™ main window, which can be broken down as:

- **Drop-Down Menu List**
  From here all the main software settings and features can be accessed in their respective category
- **Quick Access Icons**
  From here all the most used features can be readily accessed by pressing the corresponding icon
- **Spectral Graph Display**
  Spectral response populates in this graph, whether viewing past files or using live-view
- **Camera Image**
  Live camera feedback for viewing area
- **Filename List**
  List contains running notation of all filenames open in the spectral display graph
- **Measurement Control**
  Buttons activate measurement (Darkscan, Collect Sample, etc)

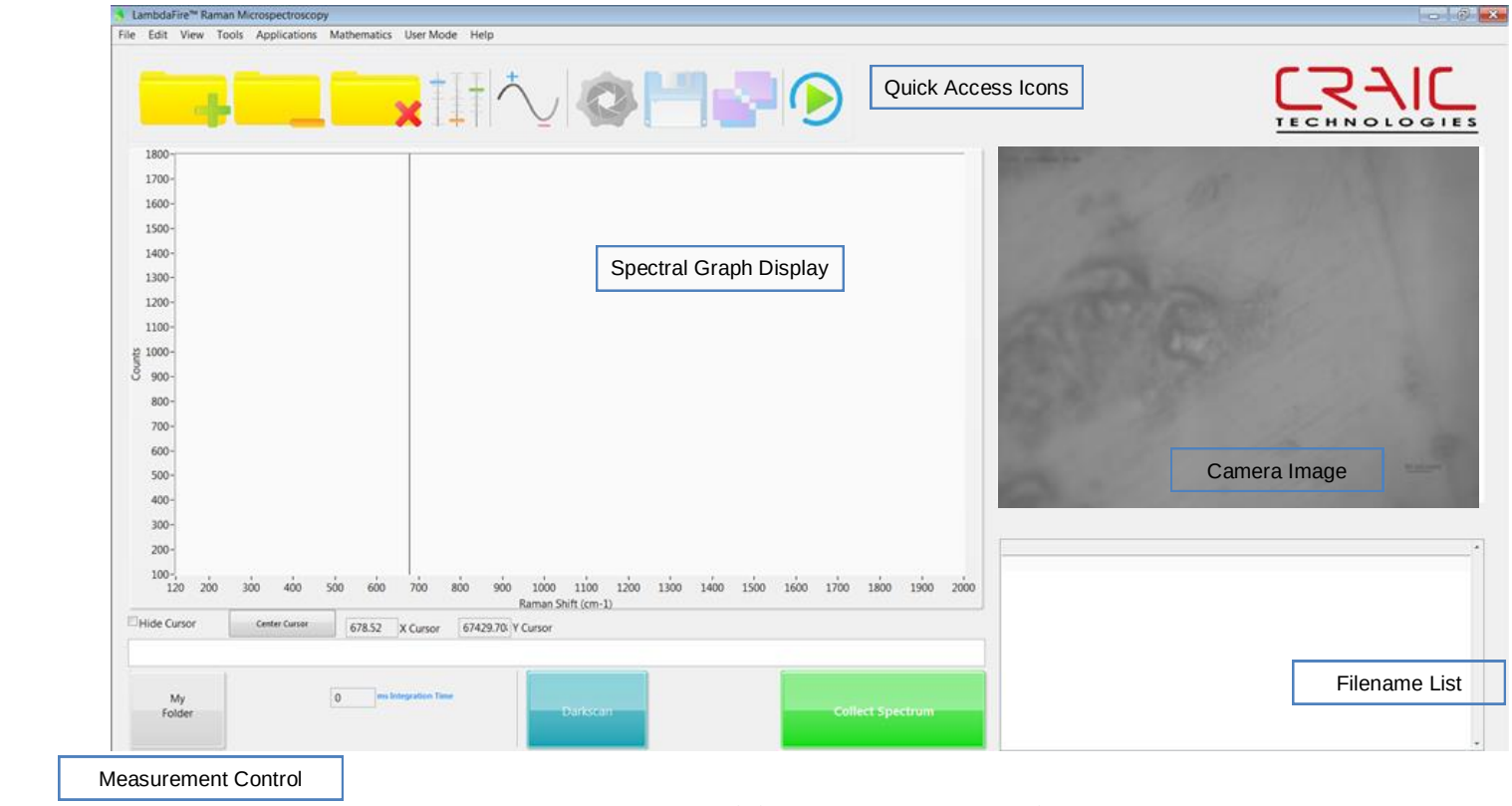

Figure 1. LambdaFire Raman™ Main Window

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Drop-Down Menu List

The **Drop-Down Menu List** is located at the very top-left corner of the main software window. From here, almost all of the software functions/features may be accessed:

- **File**
  - **Open (Ctrl + O)** Opens a browser window to select spectral file(s) for viewing
  - **Close All** Close all active spectral files
  - **Save As (Ctrl + S)** Save the selected spectral file under a different name
  - **Convert MSP Files to CSV** Convert spectral file(s) for viewing in Microsoft Excel
  - **Batch convert Folder to CSV** Convert folder contents to CSV for viewing in Microsoft Excel
  - **Export to GRAMS SPC** Export files to GRAMS
  - **Print (Ctrl + P)** Print active spectral files
  - **Exit (Ctrl + Q)** Close LambdaFire window
- **Edit**
  - **Trace Limits** Edit the X & Y value range of active spectral files for viewing spectra only
  - **Peak Picking Settings** Edit the threshold and averaging parameters for automatic peak/valley notation
- **View**
  - **Paged** View active spectral files on individual graphs
  - **Overlayed** View active spectral files overlayed on top of each other
  - **Stacked** View active spectral files spaced at even intervals on top of each other
- **Tools**
  - **Set Parameters** Edit settings for measurement (i.e., spectral range, average scans, etc.)
  - **Set Coefficients** Spectrometer coefficients (Password protected, set at factory)
- **Mathematics**
  - **Statistics** Create average of scans with options for 1, 2, -1, -2 Standard Deviation
  - **Derivative** Derivative of spectral file
  - **Integrate** Area underneath curve of spectral file
  - **Smoothing** Average of adjacent pixels (averaging)
  - **Spectral Math** Spectral math functions (i.e., multiply, subtract, divide, etc.)
  - **Normalize Current Spectra** Normalize a single active spectrum
  - **Normalize Multiple Spectra** Normalize multiple active spectra
  - **Baseline Correction** Removes fluorescence from the measurement
- **Help**
  - About Information about software version

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Icon Panel

***Icon functions from left to right**

Open File(s)

Open spectral file(s)

Close One File

Close one file

Close All Files

Close all open files

Parameters

Choose measurement settings

Peak Picking

Activate/Deactivate peak notation feature

Camera Settings

Various camera settings

Save Image

Save a camera image

Swap Camera/Graph Positions

Switch graph and camera positions (Camera image becomes more prominent than graph and vice versa)

Realtime Mode

Live spectral response view

Parameters

My Folder

- Choose where to save files by pressing **My Folder** in the measurement control panel

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- The default directory path will display, In order to change, press **Change Directory**
- Choose a directory in the file browser, then press **Select Current Directory**

Parameters

- Press the **Set Parameters** icon, in the Quick Access Icons panel
  - This window is divided into three tabs: **Settings** | **Modes**

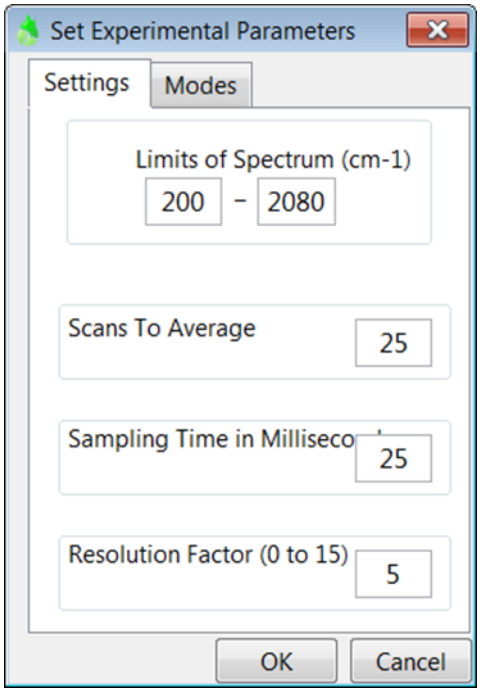

Figure 2. Parameter Settings

The Settings tab of the Parameter window will contain values for one or two spectrometers, depending upon the system configuration. Single spectrometer systems will look similar to **Figure 2**, without the additional column for the second spectrometer. From the settings tab, you may set the following items:

- Left and right limits of spectral acquisition (cm^-1)
- Scans to Average*
- Sampling time in milliseconds (integration time)*
- Resolution factor (boxcar averaging)*

*Per spectrometer

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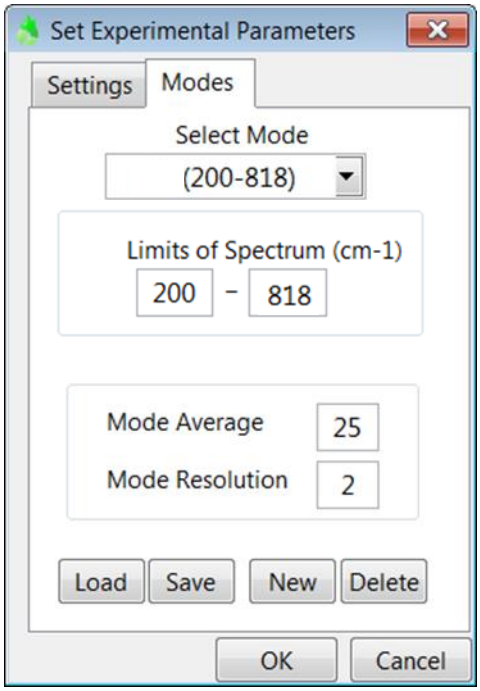

Figure 3. Parameter Modes

The Modes tab of the Parameter window contains a selection of pre-loaded measurement settings, as well as the ability to create custom measurement settings. If particular settings are preferred, the modes tab is the ideal place to save the settings for easy loading into the software. In order to apply a mode to the settings, please do the following steps:

- Press the **Parameters** icon from the quick access icons in the main window
- Press the **Modes** tab of the parameter window
- Choose the mode from the drop-down list
- Press the **Load** button in the lower left corner of the **Modes** tab

To create a custom mode, please do the following steps:

- Press the **Parameters** icon from the quick access icons in the main window
- Press the **Modes** tab of the parameter window
- Type in the selected values (mode range, average and resolution settings for both spectrometers)
- Once desired settings are input, press **Save**, and give the mode a unique label
- This mode can now be accessed from the **Select Mode** drop-down list

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Peak Picking

Peak picking will automatically detect and notate peak/valley locations. Pressing the **Peak Picking** icon in the icon panel will activate/deactivate the notation on-screen. To change peak picking settings, choose **Edit** from the top dropdown menu and choose **Peak Picking Settings**.

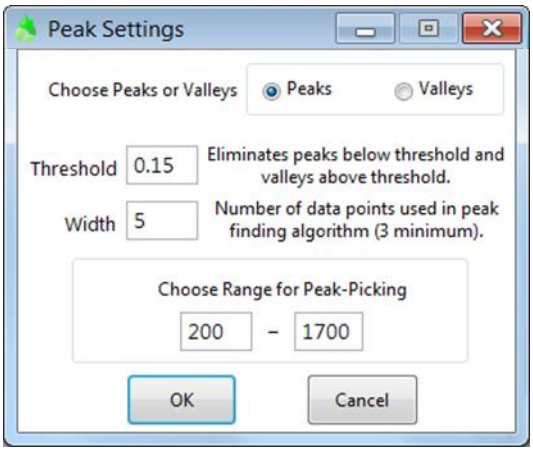

Figure 4. Peak Picking Settings

The software can be set to recognize either peaks or valley locations. The **Threshold** can be set to either eliminate peaks below threshold, or valleys above threshold. The **Width** is by default to set to 5; however, larger numbers will average peak locations over a wider range of data.

Realtime Mode

To view a live spectral response, choose the **Realtime** icon from the icon panel.
You may view the output as: **Counts (Raw Intensity)**
Press **Escape** to exit the live mode.
*You will require a valid dark and reference scan to view these live modes

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Printing spectra

To print active spectral files, choose Print from the File dropdown menu in the main window. A print preview box will appear.

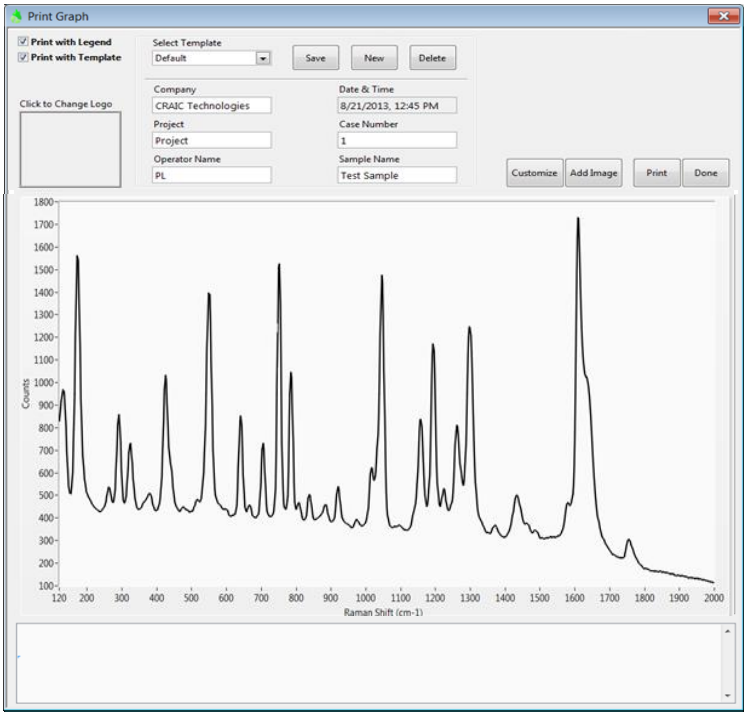

Figure 5. Print Template Window

Starting from the top of the preview box, the spectra can be printed with a legend, basically to include the colored filename list. From **Select Template**, you may add, edit, and delete print templates. Customizable information appears below, to include:

- Company
- Project
- Operator
- Sample
- Case/Tag
- Customizable Company Logo

To add an image, press **Add Image**. Use the pop-up file browser to locate the desired picture. Place the image by dragging the image box to the desired location and pressing **Drop Image.**

To add text, double-click where the text will be placed in the graph. A text box will appear with formatting options.

*Text cannot be deleted once placed on the graph. In order to remove it, the printing must be canceled and restarted.

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Camera

Camera Settings is divided into 4 tabs: **Settings** | **Signal Processing** | **Video Modes** | **Configurations**

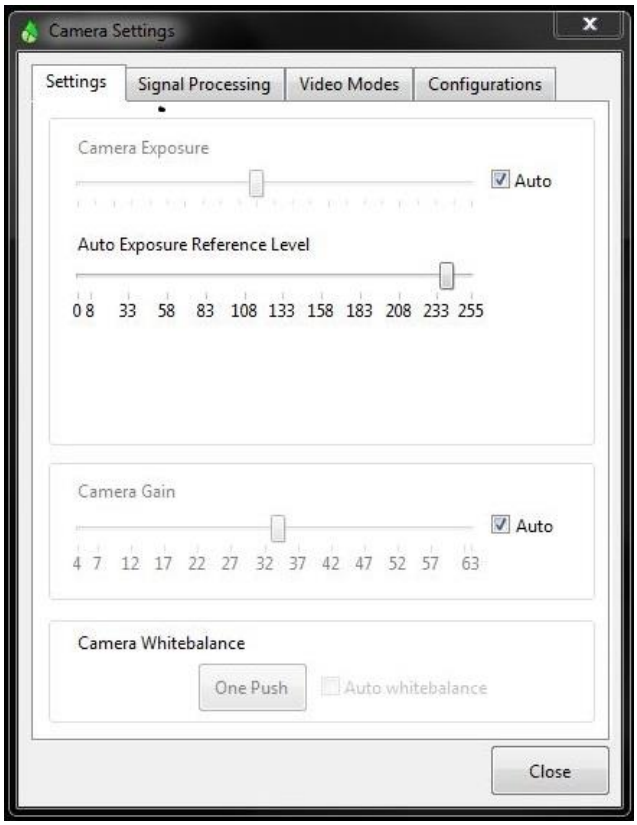

Figure 6. Camera Settings

Settings

The **Settings** tab contains prominent image adjustment tools, such as exposure, gain, and white balance.

The **Exposure** Time can be manually set via the exposure slider, or set to automatic by checking the box labeled “Auto”. (**Figure 6**)

> The **Auto Exposure Reference Level** slider is used to adjust what level of brightness the camera will attempt to achieve when exposure is set to auto.

The **Gain** level slider will affect the amount of gain in a picture. Please note that this will only amplify the intensity in the image, and could lead to a grainy or noisy image at high gain levels. It is typically best to increase exposure before gain. When **Auto** is checked for gain, the system will automatically determine the gain level.

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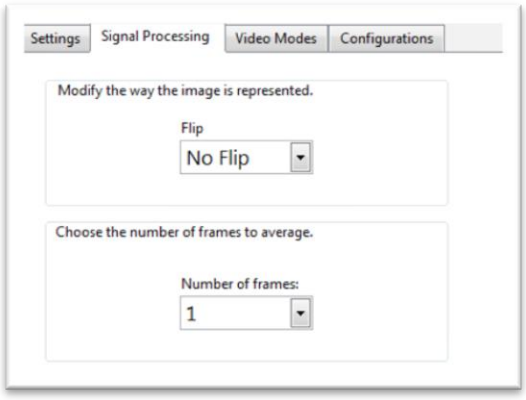

Figure 7. Signal Processing

Signal Processing

Using the **Flip** setting, the camera can be rotated and flipped vertically or horizontally. This is preset at factory for 20/30 PV systems.

The **Number of Frames** to average can be set to higher numbers; however, the default is set to 1. For extremely noisy images, it may be necessary to increase the average.

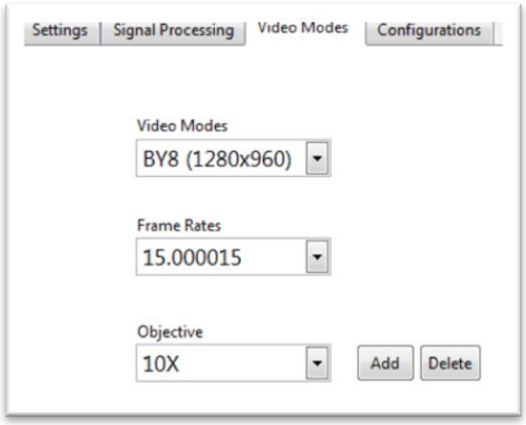

Figure 8. Video Modes

Video Modes

Initial **Video Modes** are set by default. If the camera is capable of various resolutions and colorspaces, those options will be displayed in the Video Modes dropdown list. The camera **Frame Rate** can also be changed from this menu.

Objectives can be chosen in the dropdown menu. In order to add a new objective, press **Add**, and enter the objective label, along with a pixel/length ratio if available. To delete an objective, choose it in the dropdown list and press **Delete**.

*20/30 PV will arrive with purchased objective ratios already entered by default.

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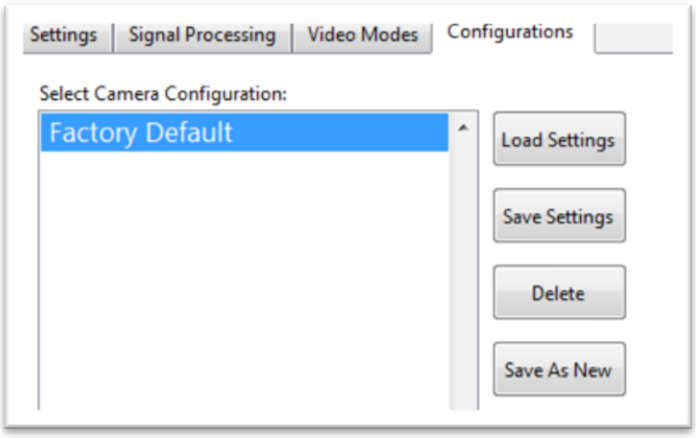

Figure 9. Camera Configurations

Configurations

Settings added to all three previous camera tabs can be saved as a **Configuration**. Along with a factory default configuration, the 20/30 PV will arrive with preset configurations for purchased objectives.

To Load Settings, choose the desired configuration to the left, which lists all saved/default configurations. Press **Load Settings**.

Once settings have been changed on a previously saved setting, press **Save Settings** to update the configuration.

To delete configurations, choose the configuration from the left list, and press **Delete**.

Once custom settings have been applied for a new configuration, press **Save As New** and enter a configuration name, to create a new configuration.

Saving an Image

To save a camera image, press the **Save** icon, located in the icon panel. Choose the save location and the file name in a pop-up file browser window.

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STARTING THE INSTRUMENT

1. Enable the power switch on the control unit.
2. Turn the laser key.
3. Pull out the laser handle; two blue warning LEDs will come on, indicating that the laser is live. The laser is only live when the handle is pulled out all the way; as soon as you push in the handle, it is disabled, regardless of the position of the key.
4. Enable the Imaging power switch on the control unit.
5. Turn on the computer and monitor.
6. Start the CRAIC Raman Software by clicking on the CRAIC icon.

RAMAN SPECTROSCOPY

The following procedure is used to take Raman spectra of samples with the Apollo™ Spectrometer.

1. Place your sample on the stage of the microscope.
2. Remove a ND filter from the laser path for full-power. Typically, lowering the power of the laser will lower the Raman signal.

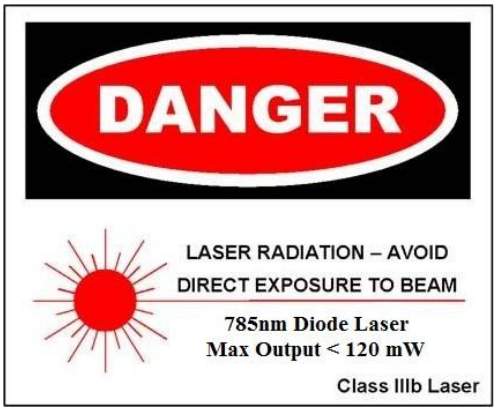

Figure 10. Danger Laser Radiation Warning

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Red radiation will be emitted at the sample. Always wear protective eyewear that filters red light before engaging the laser. Never place your hand in the laser's path, as this can cause severe burns.

3. Pull out the laser handle on the side of the instrument. This directs the beam down through the objective. **Note that the laser will not turn on unless this handle is pulled out completely**
4. Turn on the imaging by flipping the imaging switch
5. Use the stage and camera software to locate an area of interest
6. In CRAIC Raman, select Tools, Set Parameters and set the integration time to 200 ms
7. **Turn off the imaging LED by flipping the imaging switch**. The intense blue light will distort the signal if it is left on
8. Enter real-time (continuous sample) mode.
9. Adjust stage height while looking at the signal in Real-Time mode. For a solid (non-transparent) sample, adjust for maximum count levels, which means the laser is focused on the top surface. If the signal is particularly weak, you may try increasing the integration time to improve sensitivity, at the cost of a slower real-time scan

TAKING RAMAN SPECTRA

1. Push in the laser handle all the way, or place a high-ND (>2.0) in the beam path to block the laser.
2. Disable the imaging source by flipping the corresponding switch on the control unit. If you do not do this, stray light from the internal LED will influence your measurement.
3. Select **"My Folder"** and choose your data directory. This is where the program will store the spectrum files.
4. Press the **"Collect Darkscan"** button.
5. Restore the beam down onto the sample by pulling out the laser handle, and/or removing the high-ND filter.
6. Press the **"Collect Sample"** button. A screen will appear for information entry.
7. Select what kind of measurement is being acquired: **Fluorescence**. This will subtract the dark scan from the current scan.
8. Select which objective is being used.

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9. Enter a sample filename or use the last filename entered. If the file exists, the software will automatically add a number at the end of the filename and increment that number.
10. Press **Scan** to take a spectrum.
11. Place a high-ND (2.0) filter in the beam path to temporarily block the laser. For longer periods of disuse, disable the laser by pushing in the handle, or turning the laser enable key.

Never leave the laser on when it is not in use. This is a fire hazard, and may cause wear on the optical coatings used in the head unit. Always remove and store the key when the instrument is not used.

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Use with the 20/30

To use the 20/30's other features, such as the eyepiece, the LightBlade spectrometer or its visible camera, make sure the illumination light is **off** to reduce stray light**.** You must also ensure the laser handle is pushed all the way in. This disables the laser, regardless of the position of the Laser Enable turn-key, and allows light from the objective to reach the eyepiece and spectrometer.

Please note that, by design, no laser-light can ever reach the eyepiece under any circumstance. No after-market filters are necessary.

Care and maintenance

There are no user-serviceable parts in this system and under no circumstances should the head unit or the control unit be opened.

Dust protection
Protect the control unit and head unit from dust by putting on the flexible dust cover after each work session. Dust and loose particles of dirt can be removed with a soft brush or lint-free cotton cloth. If you transfer the Raman system to a different microscope, ensure that the laser aperture is covered with tape during transit.

Alignment
The system is permanently aligned and should not need any further servicing throughout its useful life. However, when moving the Raman system, **extreme caution** should be taken to avoid sudden accelerations that might cause misalignment. If the instrument has become misaligned, please contact CRAIC Technologies immediately for servicing. NEVER MANUALLY ATTEMPT RELAIGNMENT – THE HEAD UNIT MUST NOT BE OPENED BY NON-CRAIC PERSONNEL FOR ANY REASON. ANY ATTEMPTS TO DO SO WILL VOID THE WARRANTY.

Laser health
Our laser is designed for at least 10,000 hours of life.

Mains voltage
The mains (wall) voltage must be 115 V (North America). If you are moving the instrument to a country that uses 230 V mains (for example, most of Europe) you **must** take precautions to ensure that the instrument is not destroyed. Furthermore, you **must always** use surge protection technology.

All CRAIC instruments are manufactured and tested with extreme care. If you do have cause for complaint,

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however, do not try to repair the instruments and their accessories yourself. Contact your national agency or our central servicing department in California directly.

CONTACT INFORMATION:

Postal address:

CRAIC Technologies
948 N. Amelia Avenue
San Dimas, CA 91773
United States

Tel. +001 310-573-8180
Fax +001 310-573-8182

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